

REMARKS

Claims 20-47 are pending in this application and have not been amended in this Request. All of the claims have been rejected.

35 U.S.C. §103: Higgins

The Office has rejected claims 20, 22-24, 26-28, 32-34, 38-41, and 45-47 under 35 U.S.C. §103 over Higgins (U.S. Patent No. 6,294,405) for the reasons set forth on pages 3-10 of the Office Action. Applicant respectfully traverses this rejection.

The Office argues the device of Figure 1 of Higgins describes the invention substantially as claimed, except for limitation that the stud bump is located directly on the RDL pattern. The Office recognizes that the stud bump (20) of Higgins is instead located on an UBM pad (15). The Office argues, however, that eliminating the UBM pads 15 in the Figure 1 device would have been obvious because it has been held that omission of an element and its function in a combination where the remaining elements perform the same functions as before involves only routine skill in the art. In other words, the Office argues that it would have been obvious to eliminate the UBM pad (15) since the device of Figure 1 would still operate because the function of the UBM pad—serving as an electrical connection—is not required.

Such an argument fails from both a legal and a technical perspective. From a legal perspective, the Office incorrectly interprets this legal theory. The Office's internal guidelines recognize that omission of an element and its function would be obvious, but provided that the function of the element is not desired. The Office maintains, though, that such a legal theory applies since "the rejection essentially states that the function is not required." But this legal theory does not hinge on what the Office thinks about the omitted component and its function(s),

but rather what the skilled artisan believes about the omitted component and its function(s). And the Office has still not substantiated the skilled artisan—and not the Examiner—considers that the function of the UBM pad is not required.

From a technical perspective, the Office has not accounted for the fact that an electrical connection is not the only function that UBM pads perform. As the skilled artisan would have recognized, UBM pads not only serve as an electrical connection, but also insure good wettability and adhesion of the overlying stud bumps. *See Chakravorty, column 9, lines 12-15.* Thus, the UBM pads serve as more than just as an electrical connection to the stud bump. And since such functions would have been eliminated from the device when the UBM pads were eliminated, it would have not been obvious for the skilled artisan to eliminate the UBM pads as proposed by the Office. Indeed, the skilled artisan would have not wanted to eliminate the UBM pads because—at a minimum—the ability of the stud bumps to adhere to the underlying device would have been decreased.

Thus, the Office has not shown that Higgins teaches or suggests each and every limitation in the rejected claims. Accordingly, Applicant requests withdrawal of this ground of rejection.

35 U.S.C. §103: Higgins & Chakravorty

The Office has rejected claims 21, 25, 29-31, 35-37, and 42-44 under 35 U.S.C. §103 as being unpatentable over Higgins in view of Chakravorty (U.S. Patent No. 6,350,668) for the reasons noted on pages 11-18 of the Office Action. Applicant respectfully traverses this rejection.

Some of the rejected claims contain a first limitation that there exists no under bump metal under the stud bump. And other of the rejected claims recite a second limitation that the stud bump is provided on portion of the RDL pattern not covered by the insulating layer without using an under bump metal. The Office has not shown that Higgins teaches or discloses these limitations in the claims as detailed above. And the Office has not argued—much less alleged—that Chakravorty teaches or suggests these limitations. Thus, since neither reference alone teaches or suggests these limitations, it would be difficult for the Office to even argue that the combined teachings suggest these limitations.

Applicant previously argued that it would not been obvious to combine the references in the manner proposed by the Office for two reasons. The first reason is that the proposed combination would only increase the complexity and cost of the manufacturing process, as well as the thickness of the device. The second reason is that the skilled artisan would have not have wanted to add the additional solder ball of Chakravorty when the device of Higgins already contained a solder ball. The Office did not find these two arguments persuasive, primarily because the Office alleges Chakravorty describes that such a configuration is compact (among other advantages). Even if it is true that Chakravorty teaches that the configuration of his device is compact, this does not translate to teaching the Office's proposed combination would be compact.

Indeed, the Office's proposed combination shows that the opposite is true and that the proposed combination would be less compact. The Office proposes that the solder ball (314) of Chakravorty would be placed directly on stud bump (20) of the Higgins device before the substrate (50) would be attached. In other words, the Office proposes to modify the Figure 1 device of Higgins by placing the solder balls (314) of Chakravorty on the stud bumps (20) and

then placing the substrate (50) of Higgins on the solder balls (314), thereby locating the solder balls (314) between the stud bumps (20) and the bond pads (52).

Applicant continues to disagree that the Office has substantiated a *prima facie* case of obviousness. Why would the skilled artisan add a solder ball (314) on the stud bump and then add the structure 50 on top of that solder ball (314)? Such a proposed configuration would still leave the solder balls (58) on the opposite side of the substrate (50). At best, all that would have been accomplished with this proposed modification is to increase the complexity (and cost) of the process, not too mention increasing the thickness of the combined structure by the added thickness of the solder ball (314).

Indeed, how could the thickness of the proposed modification not have increased the thickness of the device of Higgins? The remainder of the device is the same since the Office's proposed modification does not eliminate any other component. But now solder balls (314) have been added between the semiconductor device (11) and the substrate (50). Adding any layer, while keeping everything else the same, must logically result in a thicker device.

An illustration of this concept can be seen in Exhibit A, which illustrates the device of Higgins when compared to the Office's proposed combination. The left side of Exhibit A is a duplicate of Figures 1 and 2 of Higgins. The upper right hand corner of Exhibit A illustrates how the solder balls (314) would be added to the device as proposed by the Office. And the lower right hand corner theoretically depicts how adding a solder ball (314) would increase the distance between the UBM pad (15) and the bond pad (52).

Indeed, the skilled artisan would have had no reason place a solder ball (314) in that location. The skilled artisan would have known that solder balls (314) were used to serve as a connection to a circuit board. Thus, why would the skilled artisan have placed a solder ball,

which serves as a connection to a circuit board, between the semiconductor device (11) and substrate (50). Neither of those two components are a circuit board. Indeed, it would have duplicated the function of the solder balls (58) already existing in the device of Higgins. And the addition of a solder ball (314), that contacts stud bump (20) and bond pads (52), might have caused problems other than increased thickness (i.e., solder reflow problems and metal alloying) that would not have otherwise occurred.


Thus, the Office has not shown that the combination of the cited references teaches or suggests each and every limitation in the rejected claims. Accordingly, Applicant requests withdrawal of this ground of rejection.

CONCLUSION

For the above reasons, as well as those of record, Applicant respectfully requests the Office to withdraw the above grounds of rejection and allow the pending claims.

If there is any fee due in connection with the filing of this Request, including a fee for any extension of time not accounted for above, please charge the fee to our Deposit Account No. 50-0843.

Respectfully Submitted,

By 

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Exhibit A

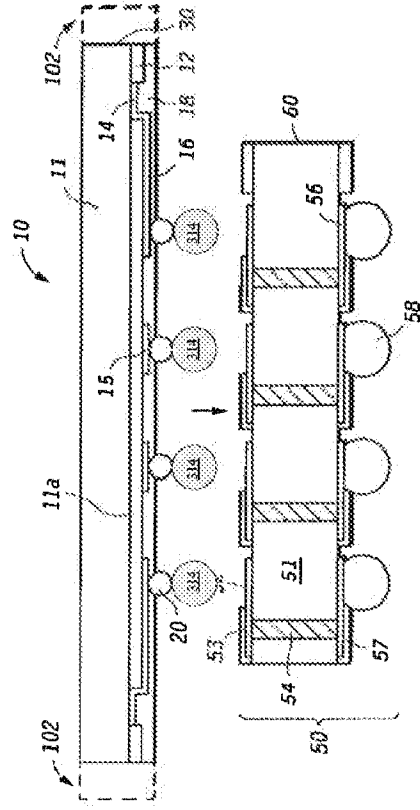
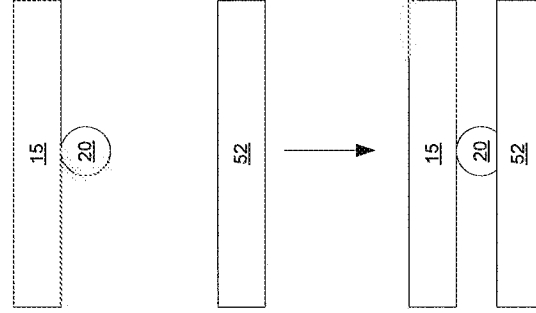
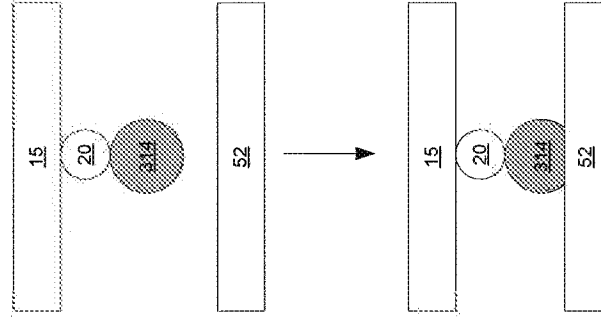


FIG. 1



Higgins



Office's Proposed Combination

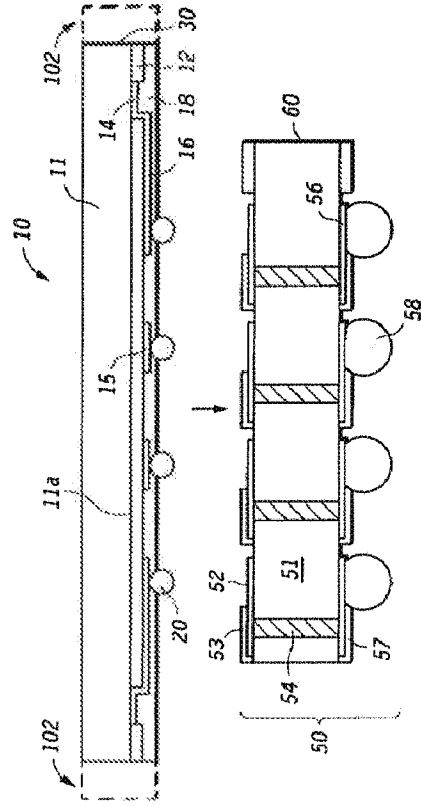


FIG. 1

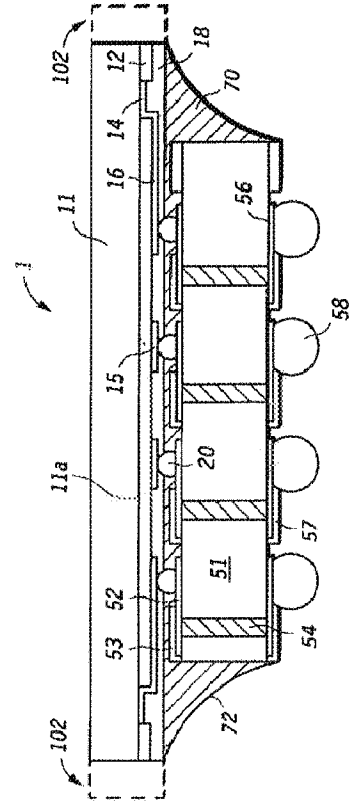


FIG. 2